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# PORTABLE CLEANERS FOR SEED GRAIN

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*Clean seed is necessary to produce cereal crops free of dockage and disease. Farmers can get their grain cleaned and treated at a reasonable price by forming a coöperative to build and operate portable seed cleaners.*

# This Circular

Tells how to organize and finance a seed-cleaning coöperative.

Describes ways of removing weed seeds and pods from cereals, and ways of treating different cereals for seed-borne diseases.

Describes the types of machine used to clean and treat grains, and the equipment needed to assemble these machines into a portable unit.

Outlines the history of grain-cleaning coöperatives in California, and describes in detail four machines now owned and operated by coöperatives in the grain fields of the state.

Gives no blueprints, but suggests sources where the new coöperative may obtain help in building the portable cleaner best suited to its needs.

Indicates volumes necessary for a successful undertaking and outlines operating details of a seed-cleaning coöperative.

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# PORTABLE CLEANERS FOR SEED GRAIN

George B. Alcorn, P. C. Berryman, and R. R. Parks

PRODUCTION of good quality cereal crops, free from dockage and disease, depends upon many factors. Among them are:

1. **Using clean seed of known origin**
2. **Planting on soil as free as possible from weeds and the seeds of other crops**
3. **Harvesting with a clean machine operated and adjusted correctly for the particular crop**

Of these, clean seed is not the least in importance, but it may receive the least attention.

## WHY CLEAN SEED?

The need for clean and treated seed is becoming greater every year. Increased travel between communities has made weed infestation more likely. The introduction of mixtures of other cereals and of new diseases has increased with (a) the expanded use of bulk handling, (b) more widespread use of harvesting equipment, and (c) mixing of varieties in commercial seed establishments, where the importance of cleaning machines out thoroughly prior to undertaking the cleaning of a new lot of seed is not appreciated.

Experiment stations have in recent years developed superior strains and varieties of cereal crops. Unless farmers use clean seed of known origin, the value of these improved varieties may be lost. This is another reason for the growing need for good seed cleaning.

Few farmers can afford to buy their own seed-cleaning and treating equipment. Warehouse separators do not always clean well enough for high quality seed, since the equipment is set for the cleaning of grain for commercial use only. Many of these machines cannot be properly cleaned following each run. Batch-treating and seed-box treating, the systems used by many farmers out of reach of commercial service, are slow, costly, and inefficient, except for small acreages.

Grain producers in California are turning to portable seed cleaning and treating equipment. In several communities such portable units are operated commercially. In other sections, growers have formed coöperatives to purchase and operate portable equipment. Their experience shows that properly managed and operated equipment can greatly improve the fields of grain. It will also cut to a minimum losses due to seed-borne diseases, such as Barley Stripe disease and covered smuts of wheat, barley, and oats.

Cleaning alone cannot make good seed grain. Seed known to be of good origin, grown on land with a clean history, and handled in clean seeders and harvesters, can be greatly improved by a good seed cleaning and treating program. Seed with a recently certified background is of first importance in present-day grain farming. This is especially true of the many disease-resistant varieties of cereals now available to most grain-producing areas of the state.

## SEED CLEANING TAKES TO THE ROAD

Portable seed cleaning and treating in California began in the early 1920's, when copper carbonate dust replaced formaldehyde and bluestone in the control of smut. The first traveling cleaner owned by a coöperative was assembled in San Luis Obispo County in 1926.* The machine, with some improvements, is still in use. San Luis Obispo County Grain Improvement Association now owns and operates four machines.

In 1928, a group of farmers from the Livermore-Pleasanton Farm Center built their first portable cleaning and treating unit. They have since changed and improved their machine several times.

In 1926, a private company in the Sacramento Valley began commercial work with a portable machine which the operators had built on their ranch near Chico in Butte County. Their first units were mounted on trailers, but truck mountings proved more practical. The same concern now operates a small fleet of cleaners in several counties of the large grain-growing areas in California. Other commercial outfits in California and in other states perform a needed service.

In recent years, several Farm Bureau groups in various counties have organized or shown interest in grain-cleaning associations. A number of community-owned and -operated cleaning and treating machines have been very successful in grain-growing states of the midwest. Growth of such coöperatives, as well as of private commercial services, has proved the worth of this method of seed cleaning and treating.

A county certified seed program, as well as an all-around cereal improvement program, can be built around a portable cleaning and treating assembly. In building such a machine, the following points should be considered:

**1) A specially built grain cleaner should include two or more cleaning units. No one operation or method of separation can clean and grade cereal seeds perfectly. And no one cleaner unit can do a complete seed cleaning job; the variety of conditions under which a portable machine must work is too great.**

**2) A treater is essential to the assembly. Many cereal seeds must be treated as well as cleaned. Even though many new cereal varieties are released with disease resistance, it is still best to treat the seed with a fungicide such as copper carbonate as an additional safeguard.**

**3) All units, including the elevators, must be set up so that a thorough cleanout can be easily done after each job.**

**4) In seed cleaning, as in harvesting, not every kernel of good grain can be saved, nor can every piece of straw be removed. If nearly complete removal of undesirable seeds or chaff is to be accomplished, some good quality seed will have to be lost.**

## HOW ARE SEEDS CLEANED?

All cereal seeds are cleaned by air blast (aspiration), rough scalping, width separation or screening, and length and weight separation by pocket grading units. In addition, barley is bearded, and vetch is passed over a gravity spiral separator.

ASPIRATION is the use of an air blast to suck or blow the chaff, dust, oat hulls, beards, and other light material from the bulk of the seed being cleaned. In order for this operation to be efficient, the air blast must be strong enough to lift some good seed in order that all chaff and other light material may be removed.

* Development of the idea, a description of the first machine, and the method used to organize the community are described in "The Combination Cleaning and Treating of Seed Wheat," U. S. Department of Agriculture Leaflet No. 33, published in February, 1929.

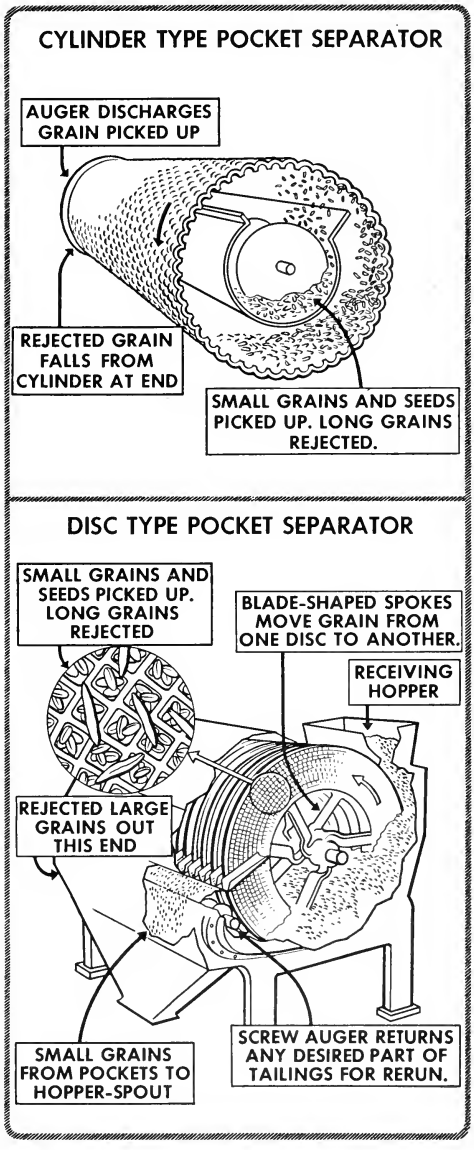
SCALPING is the use of a coarse screen, through which seed will readily pass, to remove straw, large weed seeds, burrs or pods, and other trash too heavy or too large to be removed by aspiration. The scalper screen may be flat, in which case it is shaken, or it may be in the form of a revolving cylinder.

SEED SCREENS are finer than scalper screens, and separate seeds according to width. Usually they are rectangular screens placed one above the other and slightly inclined. They may shake either lengthwise or crosswise, and should be equipped with brushes which run along the under side of each screen to keep the slots or holes from becoming clogged. Seed screens are usually in pairs, the upper screen large enough to allow good seed to fall through while holding back large weed seeds, pods, and such material, the lower screen just small enough for small and broken seeds to fall through, while the good seed grain is retained. Extra screens in many sizes may be obtained.

AIR-SCREEN UNITS sold by some manufacturers of seed cleaning machinery combine the three elements of aspiration, scalping, and seed screens into a single machine. Many such units have two air blasts, one just ahead of the scalping screen, and another which hits the grain as it leaves the second or lower seed screen. Were it not for the smallness of screen area necessary to make it portable, such a unit could do most of the cleaning and much of the grading of seed grains. However, screens can separate only by width. Seeds which have the same width but are of different lengths, such as barley and wheat, can be separated only by pocket separators.

POCKET SEPARATORS or graders perform the final operation on most cereal seeds (fig. 1). They are made up of cylinders or disks in which various-sized pockets are punched or cast. This is the length or weight separation necessary for a first class seed-cleaning job. The small pocket units remove additional small seeds and cracked kernels. The medium pockets raise wheat or vetch out of barley or oats and the larger pockets raise barley and refuse oats. Oats are refused in most pocket grading operations. Many adjustments are possible to meet the requirements of different grains.

**FIGURE 1**



GRAVITY SPIRAL SEPARATORS are an essential unit in cleaning vetch seed. The machine admits the seed from a pocket grader at the top. As the seed stream gains speed down the spirals, the round, heavy vetch kernels roll faster and are thrown over the edge of the spiral ribbons into an outer trough. The flat kernels of other grains (some of which are always picked up in the pocket machine in order to get all of the vetch) travel more slowly and are retained on the first spiral ribbons. Wind may interfere with this gravity separation process, and spiral separators should be enclosed.

CONDITIONING BARLEY. In some barley-growing areas, harvesting does not uniformly remove the beards on certain varieties of barley. In order to grade seed properly later in the cleaner unit, the bearding operation is carried out first by passing through a unit similar to the cylinder on a peg-tooth type harvester. This operation should be close enough only to make all kernels about the same length and not remove the skin of any more kernels than is necessary.

## CLEANING METHODS FOR INDIVIDUAL GRAINS

All grains contain some chaff and straw, most of which can be removed by aspiration and scalping. Each seed grain has its own problems in the way of weed seeds and other cereals.

WHEAT usually contains some wild oats, barley seed, and such weed seeds as fiddle-neck and mustard. A pocket separator, either disk or cylinder, will remove these, and broken kernels as well.

BARLEY often contains radish pods and tecolote burrs, as well as oats, wild oats, wheat, fiddle-neck, and mustard. The best practice is to remove all large weed seeds on the top seed screen of the air-screen unit, and as much of the small oats and other small seeds as possible through the bottom seed screen. Grading can then be finished in a pocket separator, where the smaller pockets will remove the remaining small seeds, wheat, and cracked and undersized barley kernels, and large pockets will pick up most of the good barley, and the oats and other larger material will go into the tailings sack.

OATS are easily cleaned except for barley and wild oats. Most other seeds can be removed with the seed screens or a pocket separator. Most of the short, heavy barley kernels are readily removed from oats by the larger pocket cylinder. The long, slender barley kernel, which is very similar to the oat kernel in size, cannot be separated from oats, and the only wild oats which can be removed from tame oats are the light-weight kernels which are removed by aspiration, or the small kernels taken out through the lower seed screen.

VETCH AND OATS can be cleaned and separated in one operation in a unit combining aspiration, scalping, seed screens, pocket separators, and gravity spiral separators. Chaff, vetch pods, straw, mustard seed, radish seed and pods, and wild oats and barley are the chief materials to be removed from these grains.

## SEEDS NEED TREATMENT

Treatment of seed to control seed-borne diseases is an important step in preparing seed for next year's crop. By seed-borne is meant those diseases carried by the seed itself, not infections which are contained in air or soil. In California, the more important seed-borne diseases are smuts of wheat, barley, and oats, and Barley Stripe disease. Copper carbonate and New Improved Ceresan (a proprietary mercury dust compound) are the best fungicides for control of these diseases. Both of these dusts are easily handled in a drum-type, continuous-flow treater with agitator. Both are finely ground and must be carefully measured

according to the manufacturer's directions. They are fed into the grain stream by an adjustable precision powder feed measuring device.

WHEAT needs to be treated for Bunt or Stinking Smut. Any good drum-type treater can do the job. When wheat is not stored under proper conditions, New Improved Ceresan may cause injury to the seed. If the manufacturer's directions cannot be followed, copper carbonate should be used. Both dusts, when properly used and stored, are satisfactory for wheat-seed treating. Wheat seed requires 2½ ounces of copper carbonate per bushel, or ½ ounce of Ceresan per bushel.

BARLEY must be treated for Barley Stripe disease, Covered Smut, and Black Loose Smut. One half ounce of New Improved Ceresan per bushel of barley will control these diseases.

OATS are also attacked by Covered and Loose smut, and should be treated in the same manner as barley.

## WHAT YOU NEED

If you are thinking of starting a seed-cleaning coöperative, details of organization and operation are discussed later in this circular. In choosing your equipment, you can get help from many sources. Four machines now in operation are described here, and table 1 (below) shows the purpose and cost range of the units you need. Manufacturers' buyers' guides, such as MacRae's "Blue Book," may be obtained from most machinery dealers. They list types of seed-handling equipment and the companies which make them. All manufacturers publish leaflets describing their machines, and have representatives in the field to discuss problems and give demonstrations. Your local Farm Advisor will be glad to help you plan the portable cleaner best suited to the needs of your area.

In all portable cleaners, the seed to be cleaned follows the path roughly indicated in the accompanying "flow sheet" (fig. 2): from receiving hopper to

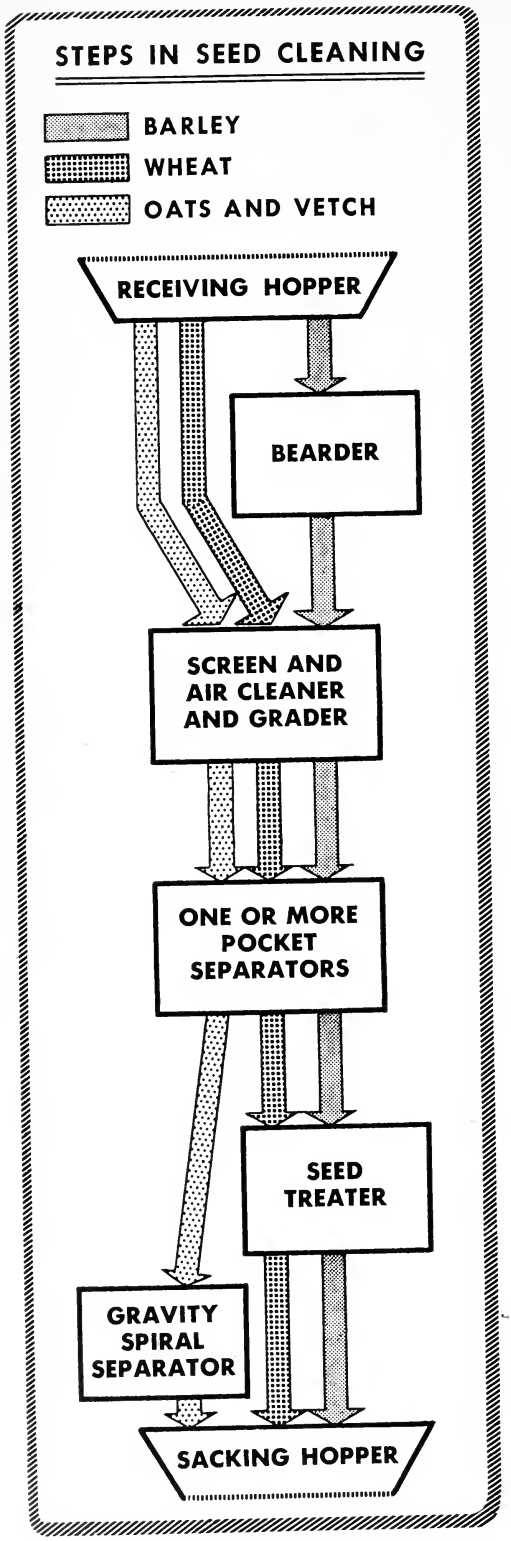
**Table 1**

**TYPES OF EQUIPMENT**

**Units Needed and Cost Ranges for a Portable Unit**

| Equipment | Purpose | Cost ranges |
|---|---|---|
| Truck | Transportation | $300–$2,000 |
| Engine (clutch) | Power for unit | $200–$400 |
| Bearder | Condition barley and vetch | $75–$200 |
| Screen-air unit | Scalping and rough cleaning for final grading | $300–$900 |
| Pocket cleaner | Final cleaning and grading | $500–$1,000 |
| Spirals | Special to separate vetch | $250–$350 |
| Treater | Applying fungicide dusts | $75–$150 |
| Elevator (3–5) | Elevate seed to units | $50 up, each |
| Auger conveyor | Convey seed to units or to elevator (save space) | $25–$50 |
| Air compressor | Clean up after each job | $50–$200 |
| Shafts, pulleys, and bearings | Hook up and distribute power | $100–$250 |
| Metal work | Connect elevators to units | $200 up |
| Iron and welding | Brace, support, and anchor units | $300 up |

FIGURE 2




bearder, to air-screen unit to pocket separator, to spiral separator, to treater, to sacking hopper. Where an operation may not be needed for all grains, as in the case of the bearder and the spiral separator, a by-pass is constructed around it. In some assemblies the treater also may be by-passed. Where particularly thorough cleaning or grading is desired, conveyors and elevators may be arranged to permit a re-run. Seed from all these machines may be either sacked or bulk-binned.

In addition to the main cleaning and treating units already described, a number of other pieces of equipment are necessary to assemble a complete portable cleaner. These include a truck to mount and transport the assembly, an engine to give it power, and an air compressor to clean it, as well as elevators, hoppers, and conveyors. Numerous shafts, bearings, pulleys, and belts are also required to operate the cleaner.

California grain-cleaning associations prefer trucks to trailers for mounting equipment, because they travel better over rough roads and fields. Several groups increased the usable length of their trucks by welding extensions onto the truck beds. Pieces such as the longer elevators and hoppers, which project much beyond the truck body when the assembly is set to operate, are attached in such a way that they may be moved into a better position for traveling, or taken off and carried separately.

Power supplied by one of several types of engines is conveyed to the machines on the truck body by means of belts or chain drives attached to a line shaft. It is possible to use the truck engine as a source of power.

To do a thorough clean-up of the machines after each job, an air compressor is needed, with enough hose to reach all parts of the assembly. Special clean-out gates in elevator boots make their cleaning easier. The compressor need be belted to the line shaft only for the clean-up process.

Receiving hoppers usually are large enough to hold one 2¼-bushel sack of grain, and are equipped with an adjustable gate which controls the flow of grain to the first elevator. Near the receiving hopper most units have a platform rest where the sack twine is cut. Elevators may be built from standard parts or purchased as units and adapted to fit the needs of the assembly. Sacking boxes act as a settling chamber for excess dust in treated grain, and usually hold a little more than a sack of seed. When the machine is properly adjusted according to wind direction, there is small danger from dust to the man sacking seed, even without a mask.

# CALIFORNIA CLEANERS

***The four portable cleaners described in this section have been used in California for many years. Three of them were built to handle one or two specific cereals, and one is a combination machine for cleaning many kinds of seed. All of them have been changed and modernized frequently to obtain the best possible results.***

## BARLEY AND OAT MACHINE

Although built to clean and treat barley and oats, this machine (fig. 3) has also been used with good results on wheat and sudan. Its chief units are bearder, air-screen cleaner, pocket separator, and treater. In the area where this machine has worked for ten years, the common materials to be removed from the seed grain, besides chaff and hulls, are morning-glory, radish, fiddle-neck, mustard, and tecolote seeds. Treating is done to control smuts and Barley Stripe disease.

All of the elevators used here are adaptations of the Hart-Carter wagon-box elevator. They are equipped with oil-treated hardwood bearings, flanged inside pulleys, and buckle-adjusted belts running between 300 and 325 linear feet per minute. The number one elevator has 4½- by 2½-inch cups spaced 5 inches apart, and can handle as much as 6,000 pounds of grain an hour, although it is seldom called on to move more than 3,000 to 5,000.

The Wagner bearder, made in San Francisco, has a capacity of 6,000 pounds per hour, and was specially built for this assembly, because the smallest in regular stock handled 20,000 pounds per hour. It has 8 teeth on the rotor and 8 on the sides of the drum. A by-pass from the elevator head to the air-screen unit is used for grains other than barley.

The Eureka No. 1 air-screen cleaner has a scalper screen, two seed screens, and two air-blast sections. Trash from the scalper screen drops to the ground. Light chaff from the air sections is blown free over the front of the truck through flexible canvas tubes, while the heavier material collects in a settling chamber and is augered out into sacks.

The Superior Junior No. 3 pocket cylinder separator, made in St. Paul, has a rated capacity of 6,000 pounds an hour, but in the field here its capacity has been 5,000 pounds. It has three cylinders. The large top cylinder, No. 18, has a smaller No. 10 cylinder set inside it. Below them is a No. 20 cylinder with pockets larger than those of No. 18.

When barley is being cleaned, it first enters the No. 18 cylinder, where the pockets take small barley, wheat, and hulled oats out of the good barley seed and dump them into the No. 10 cylinder, from which these smaller grains are spouted and sacked. The good barley seed is augered from the No. 18 cylinder to the No. 20, where the pockets pick up the good seed and refuse longer grains such as wild oats. The unwanted material is spouted out and sacked, while the clean seed barley is elevated to the treater.

Oats follow much the same route. No. 18 cylinder picks up smaller grains and puts them in the No. 10, while the good seed is passed to cylinder No. 20. The pockets of this cylinder remove small oats and barley from the good seed oats, which are then elevated to the treater, or are sent through a by-pass to the sacking box.

When wheat is handled by this machine, it is passed through the first two cylinders. Pockets in the No. 18 cylinder pick up the wheat, and dump it into the No. 10 cylinder. The pockets of this cylinder pick out the small seeds and broken wheat kernels leaving the clean wheat to be elevated to the treater or by-passed to the sacking hopper.

The Calkins No. 3 treater, made in Spokane, Washington, can treat 6,000 pounds of grain an hour. Its drum is 36 inches long and has a diameter of 16 inches. Angle-iron agitators revolving on a shaft at 50 RPM (revolutions per minute) mix the dust and seed thoroughly. This treater is equipped with a precision powder feed which can be adjusted to deliver from ½ ounce to ½ pound of dust per bushel of grain treated.

The entire assembly is powered by an air-cooled AC 4 Wisconsin 4-cylinder engine with 12 to 22 horsepower. It is adjusted by a governor to operate at 1700 RPM, and is belted to the fan shaft of the Eureka air-screen unit. The fan shaft in turn is belted to a line shaft from which three elevators, the treater, and the pocket separator are driven. A second line shaft is belted to the opposite end of the Eureka fan shaft, and powers the rest of the equipment, except the bearder, which is driven directly from the fan shaft.

This portable seed-cleaning unit is mounted on a 1½-ton truck chassis to which a 2-foot extension has been welded. Its usable length is 146 inches, its width 32 inches. The wheel base is 157 inches. Loaded, the truck has a clearance of 12 feet, 6 inches, which can be reduced to 11 feet by lowering the No. 1 elevator. The receiving hopper is also removable.

The truck carries simple fire-fighting equipment—one soda-acid extinguisher, one carbon-tetrachloride extinguisher, and two buckets for water. Extra screens for the Eureka air-screen unit are kept in a wooden box on the cleaner. For the upper position, screen sizes kept on hand are 8-, 9-, 10-, 11-, and 12/64 by ¾-inch slots. For the lower position, they are 3-, 4½-, 5-, and 6/64 by ¾-inch slots.

## WHEAT MACHINE

This portable cleaner (fig. 4) has been used on the Carriso Plains of San Luis Obispo County since it was assembled in 1929. Simpler than the barley and oat machine just described, its main units are two types of Carter disk pocket separators, a double rotor and a single rotor.

Grain is fed from the receiving hopper into the left leg of the Hart-Carter double-leg elevator, and is carried to the feed hopper of the Carter Double Rotor Farm Separator. After passing through the aspirator and scalper, which are a standard part of this machine, the grain goes to the top rotor of the disk separator. Here size B disks pick up good usable seed, leaving trash and long seeds to be spouted and sacked. The good seed goes to the lower rotor of the separator, where size A disks pick out wheat seeds from barley and oats that may have been picked up by the first rotor. Overflow wheat and other seeds from this rotor are returned to the receiving hopper for re-run.

Wheat picked up by the pockets of the second set of disks is spouted to the second leg of the double-leg elevator, taken to the top, and spouted to the second Carter disk separator, which has only one rotor. Here the small pockets remove small kernels and cracked grain, while the clean seed wheat is elevated to the treater.

The Calkins No. 3 treater is the same as that used in the barley and oats machine just described. Like the rest of the equipment on this assembly, it handles about 4,500 pounds of seed an hour.

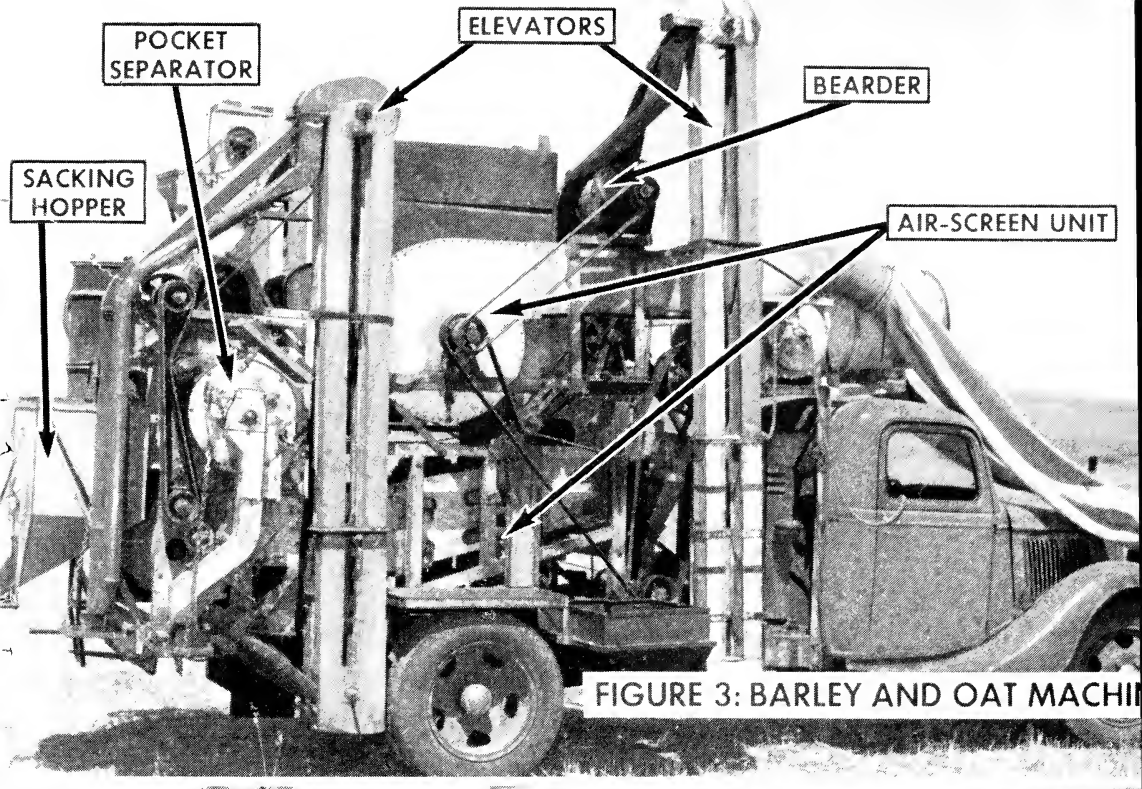
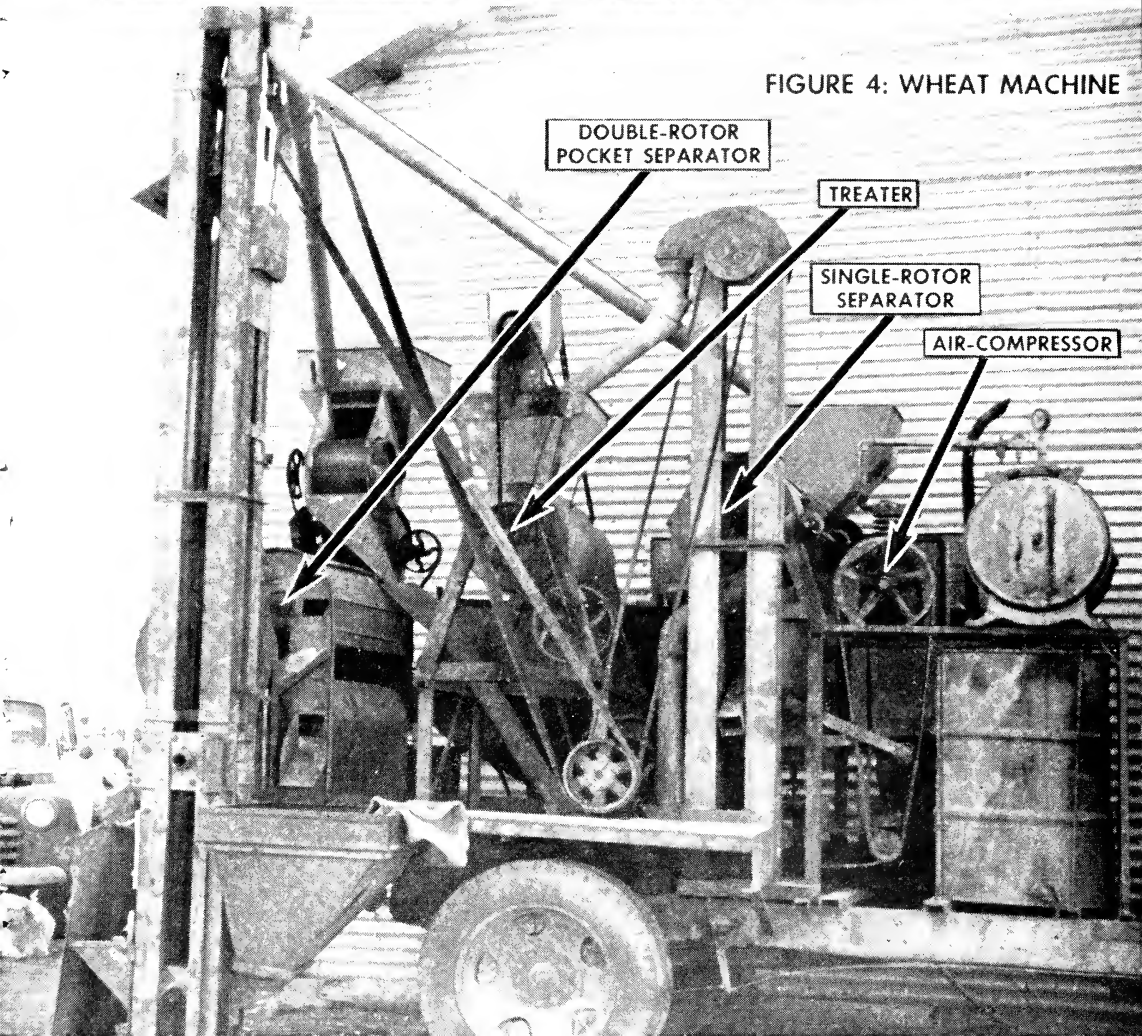



FIGURE 3: BARLEY AND OAT MACHI

FIGURE 4: WHEAT MACHINE



This wheat-cleaning unit is powered by an air-cooled, single-cylinder Model AHH Wisconsin motor running at 1355 RPM. It is belted to a single line shaft from which all equipment on the truck is driven. Mounted above the engine, the single-cylinder Model EM 3618 Kellogg air compressor runs at 350 RPM. The entire asembly is mounted on the 11-foot chassis of a used truck. With the double-leg elevator down in travel position, the equipment has a road clearance of 10 feet, 6 inches.

## VETCH AND OAT MACHINE

This unit (fig. 5) was assembled to clean vetch and oats and to separate them when the two are grown together as a crop. It has a bearder, an air-screen unit, both cylinder and disk separators, and two double spiral gravity separators.

Grain is elevated from the receiving hopper to the bearder, where unthreshed vetch pods are broken. This bearder was made locally. The cylinder is 30 inches long and 12 inches in diameter, and is equipped with a number of both stationary and rotating teeth. It is driven at 537 RPM.

From the bearder the seed falls to the Standard air-screen unit, which has three 30- by 42-inch screens and one blower fan. With the trash removed, the clean oats and vetch seed is elevated to the Junior Superior pocket separator which has three cylinders, Nos. 12, 18, and 20.

Most of the vetch entering the No. 18 cylinder is picked up, along with small and cracked seed. and dropped into the No. 12 cylinder. Here the pockets pick up the small weed seeds and cracked vetch seed and send them to a sacking spout. The vetch from this cylinder is elevated directly to the spiral separators.

Not all of the vetch travels this route. That which the No. 18 cylinder fails to pick up is passed to the No. 20 cylinder, where it is separated with small oats and some barley from large oats. From this cylinder it is elevated to the single-rotor, Carter disk separator. Here the vetch is picked out of the small oats and barley. It is then spouted to the vetch spout from the No. 12 cylinder and elevated to the spiral separators.

Oats which enter the No. 18 cylinder are freed of most of the vetch and all small and cracked seeds, and then passed to the No. 20 cylinder. Here the remaining vetch, small oats, and barley are picked out of it, and the good oat seed goes directly to the sacking spout.

An auger distributes the vetch which has been elevated from both cylinder and disk separators to two spiral gravity separators, each of which has two sections. Vetch rolls over the edge of each spiral section into the outer troughs and flows to a sacking spout, while any remaining flat grains descend the inner spirals to the bottom. These spiral separators are housed in sheet metal to protect them from wind.

## COMBINATION MACHINE

The combination unit shown in figure 6 was built in 1939 and cost, including the truck, about $4,500. According to the three members of the operating crew, it will clean and treat 35 to 40 sacks of wheat an hour, and 30 to 35 sacks of barley. It has a bearder, an air-screen unit, a combination disk and cylinder separator, and a treater. An air compressor for clean-up was added to this assembly after it was completed, and the coöperative which owns the unit may soon add a house trailer to provide meals and sleeping quarters for the crew.

Grain is taken by an Emerson steel elevator from the receiving hopper to the bearder, or through a by-pass to the Eureka No. 4 air-screen unit, which has a scalper screen, two air sections, and two seed screens equipped with traveling brushes. From here the seed is augered into a second Emerson elevator and carried to the Carter disk cylinder separator, Model No. 2131. The disks in this machine are of three sizes, 12, 11, and

FIGURE 5: VETCH AND OATS MACHI

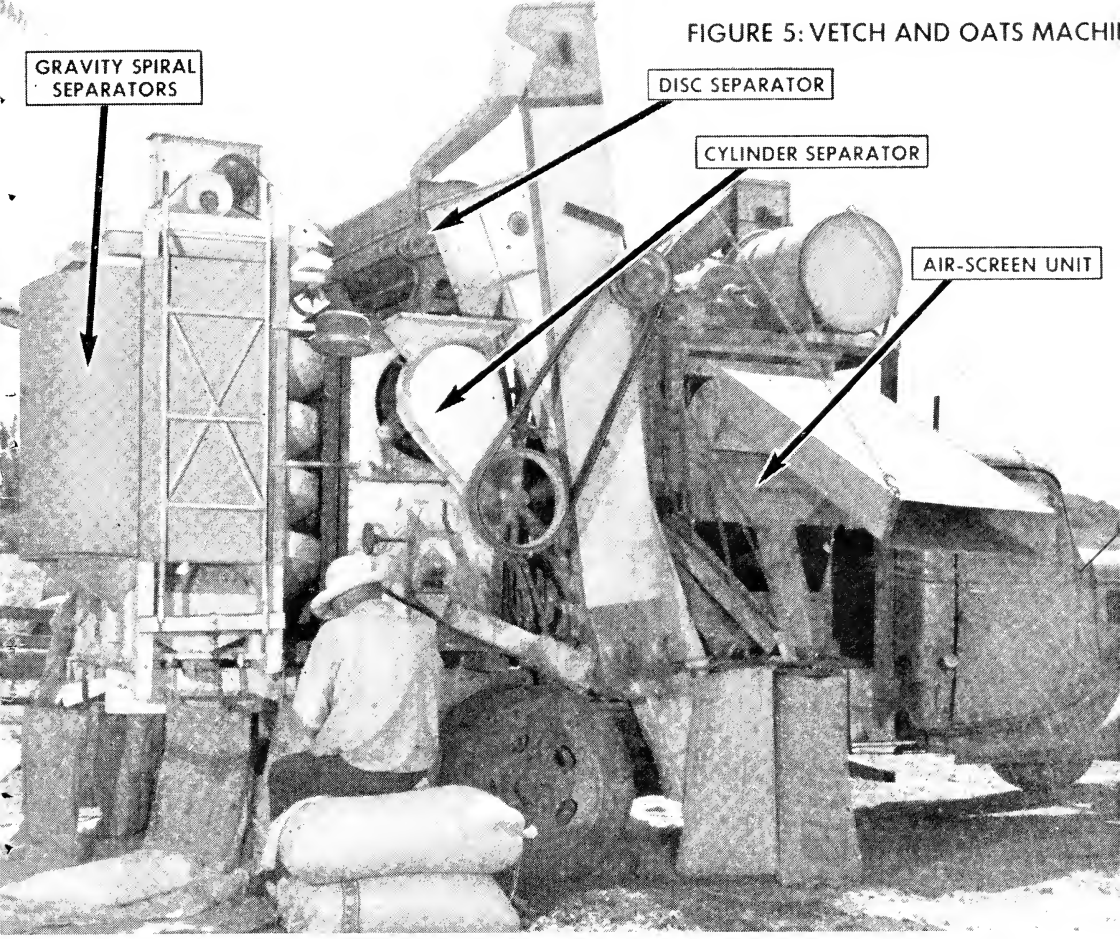
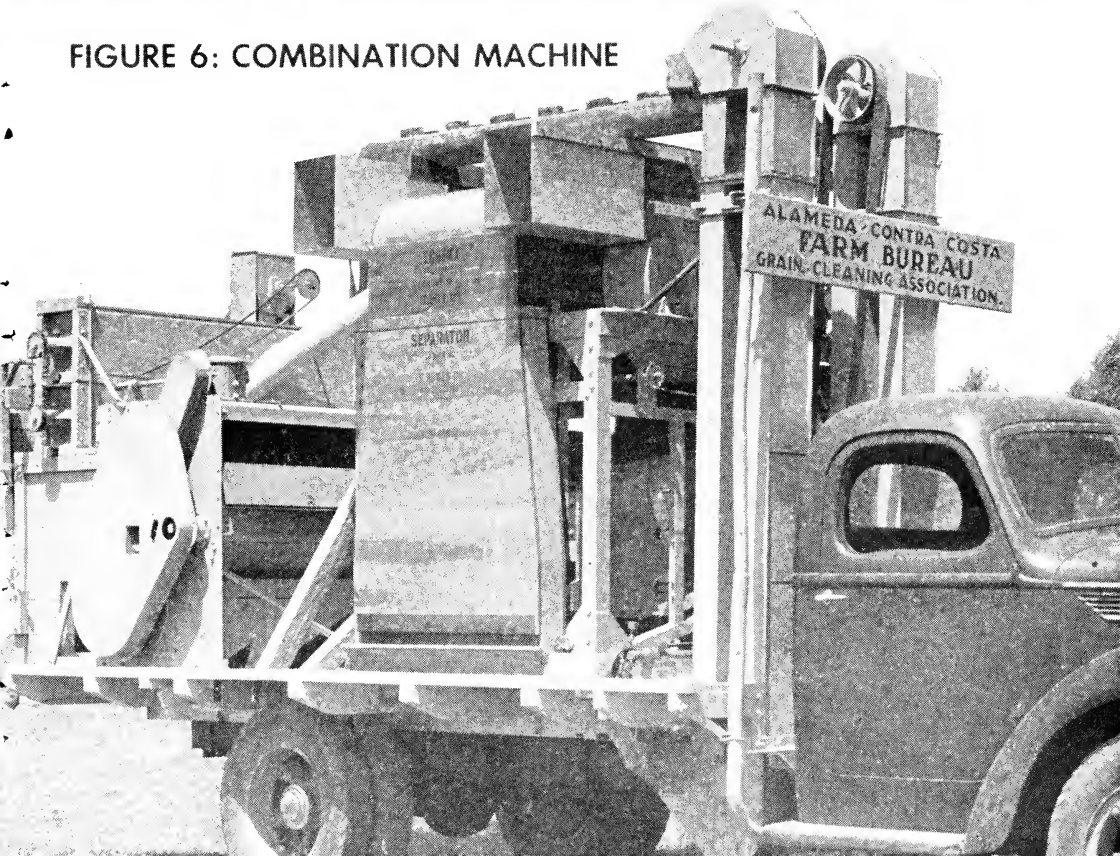



FIGURE 6: COMBINATION MACHINE



7, and are followed by a cylinder separator. This combination makes possible a wide variety of separations according to length and diameter of seed.

Both the refusal and the pick-up from the cylinder separator can be run to a third elevator which lifts the seed to the John Gray treater, or via a by-pass to the sacking box.

The 1½-ton truck on which this unit is mounted has a 173-inch wheel base. The bed is 15 feet long and 8 feet wide. Road clearance is 10 feet. On this assembly the truck engine furnishes the power to drive the machines. Some trouble was caused by overheating, because the cooling capacity of the radiator was not great enough when the truck was not moving. During one season the engine governor failed and the motor had to be controlled by hand. Some of the chain drives used caused machine breakage and had to be replaced. Belts, which would slip, might have prevented this damage.

## IF YOU'RE BUILDING A PORTABLE CLEANER . . . Keep These Points in Mind

1. Engine should be operated to obtain maximum torque, not necessarily maximum horsepower. Most units in a cleaner assembly have a narrow speed range for proper operation, so constant speeds give best performance.

2. Belt cup élevators of the type described here should be operated at 300–325 linear feet per minute for best results.

3. V-belts are better than flat belts for these machines. Where multiple drive is used, the belts should be matched. Chain drives should be used only where low speeds or heavy torque make it necessary. When used, they should be supplemented with slip clutches. When clogging or overloading occurs, chains may cause machine breakage where belts would slip. All drives and moving parts should be guarded as a safety measure.

4. Pocket separators are very sensitive to speed variations, and must be kept level to load properly. Follow the maker's operating instructions carefully and carry a carpenter's level on the truck.

5. Treaters should be operated at about 50 RPM. Lower speeds do not allow the dust to mix thoroughly; higher speeds injure seed.

6. Bearders with the diameters of those described here will injure seed if operated above 750 RPM.

7. Selecting bearings carefully will save you time and expense later. Oil-soaked wood bearings give good service on elevators. Self-aligning, roller or ball bearings, grease-packed, give smooth operation and low maintenance cost on any machine.

8. Where flat belts are used, provide idler pulleys which can be easily and quickly adjusted. Flat belts should be rubber covered and fitted with patented wire lacing to save on maintenance.

9. Grain is not water. Therefore, larger and steeper spouts than the ones usually made by a tinsmith are needed on these machines. Grain spouts should have a fall of at least one inch to every two inches of spout length.

10. Welded iron boots on elevators are well worth their cost. Iron spouts are also practical because they seldom leak. This saves annual repairs.

11. Keep a paint gun with the air compressor on the truck, and use a metallic zinc paint to cover rust. It will add to both the life and the appearance of the equipment.

# HOW TO START A COÖPERATIVE

Grain producers who are interested in cleaning their seed coöperatively must face not only the problem of getting the necessary machinery, but also the problem of setting up a workable organization. Before discussing this second problem, let us point out what is expected of a coöperative.

A farm coöperative is a nonprofit association formed to market farm products, purchase supplies, or perform some service for farmer-members at actual cost. The grain producer who joins a seed-cleaning coöperative does not expect big dividends on his investment in the association, but he does expect his coöp to clean and treat his seed at cost.

Since expenses for a future period can be only roughly estimated, operation at cost means charging a fixed rate calculated to cover all foreseeable expenses with a margin of safety. The member will expect costs to be kept down, and any amounts left over to be returned later through a refund based on patronage—the amount of business each member has done with his organization.

A coöperative member will expect equal treatment among members, which means, in this case, setting up a price scale fair to every grower. He will also expect to have his fair share of property rights in the association.

To do all this, the coöp must have (1) good management, (2) a large enough volume of business, (3) good financial backing, (4) able leadership, (5) a workable form of organization, (6) reliable records, accounts and audits, and (7) an informed and interested membership.

MAKE AN ECONOMIC SURVEY. Before starting a coöp, grain producers in an area must first find out whether there is enough interest among them. Then they should decide whether there is an economic need for such a coöperative. Are the services already available at reasonable prices? In what ways could members benefit from a coöp? Could it be made into a workable business unit? If a survey indicates a need, sufficient interest, and adequate volume to justify the undertaking (see section on "Volumes and Costs," p. 19), the group may proceed to organize.

ORGANIZE AND INCORPORATE. Some form of organization is necessary to provide for action on a majority vote rather than on unanimous consent. Incorporation is desirable, for it makes possible the limiting of each member's liability. Chapter 4, Division 6, of the Agricultural Code of the State of California permits producers to form an association ". . . . for the purpose of engaging in any activity in connection with the production" of agricultural products. Two general forms of coöperatives are permissible: the stock type and the nonstock, or membership, type. The membership type is more popular in California.

If the organizing committee decides to incorporate, it should prepare and file its Articles of Incorporation with the Secretary of State. The Articles of a nonstock association must state:

**The name of the association**

**The purpose for which it is formed**

**The county where the principal office is to be located**

**The number of directors, and the names and addresses of incorporating directors**

**The bases of voting and setting up of property rights**

Stock-type coöperatives need to file additional facts; State requirements may be found in Section 1196 of the Agricultural Code. Except for the costs of filing and legal fees, the only expense of incorporation is payment of a small annual franchise tax.

PREPARE A SET OF BY-LAWS. After incorporation, the coöperative must draw up and adopt a set of by-laws to govern its own general operations, including details of membership, directors, officers, meetings, property rights, voting, and handling of finances. These by-laws must not conflict with the Articles of Incorporation.

The filing of Articles of Incorporation and the adoption of a set of by-laws complete the legal steps needed to form a coöperative. Some associations find it desirable to have a membership agreement which sets forth the relationships between the individual member and the coöperative. This may be either a part of the by-laws or a separate document. These contracts are sometimes necessary to assure the association of enough business to maintain its credit position and aid its development.

ELECT A BOARD OF DIRECTORS. When the organization is complete, a board of directors must be elected, unless the group decides to leave the incorporating directors in charge for a while to get the business going. In the beginning, this will involve considerable detail, such as selecting and buying equipment, making arrangements to finance its purchase, setting up the details of operating, fixing charges, hiring management, and establishing over-all policy.

FINANCE THE COOPERATIVE. The association needs a certain amount of capital for equipment and for operation. No matter how carefully an organization is set up, it cannot succeed without enough funds to get a good start. The willingness of members to put their money into the coöperative will show the creditor how good a risk that organization is. Creditors usually insist that members put up at least half the money needed to buy equipment. How much money can be borrowed to start operating that equipment will depend on the local situation. Since a grain-cleaning association begins to collect income as soon as it starts to operate, this fund will not have to be very large, but some working capital is necessary.

The coöperative which is organized with stock can obtain part of its first funds from sale of stock. Additional capital can be gained from the sale of nonvoting stock to nonmembers. Nonstock coöperatives are usually financed on the revolving fund plan (see below). Stock coöperatives can also use the revolving fund method by revolving their stock.

Each member should contribute to these first funds for equipment and operation an amount based on his expected patronage—the number of sacks of grain he expects to have cleaned and treated each year. Large-scale growers who will receive greater benefit from the coöperative should contribute the larger share of the starting capital.

THE REVOLVING FUND METHOD is a very popular method of financing a coöperative, largely because it insures the fair distribution of property rights among members. Each member should contribute to capital needed according to his patronage, which means that his share in the net worth of the coöperative will also be in proportion to patronage. The revolving fund method makes certain that this balance is established and maintained, even though members withdraw, new members join, and large-volume producers associate with small producers.

By this method, a new coöperative obtaining its first capital from the subscriptions of members will credit each member with his contribution. After the association begins to operate, more funds may be accumulated by withholding the overcharges rather than making an immediate patronage refund. Some coöperatives prefer to collect this additional capital by earmarking a part of the charge, so much a sack, to be retained. However obtained, these amounts become part of a revolving fund in which every member

receives credit for the amount he contributes. Thus, if a grower has fifty sacks of grain cleaned and treated, and the coöperative charges him two cents per sack more than actual cost to clean his grain, then one dollar is credited to that grower on the coöperative's books.

The two tables included here show how this method might be used to buy a coöperative grain-cleaning and -treating machine costing $5,000. Let's suppose that the members will subscribe $2,500 on the basis of expected patronage, and the coöperative borrows the other $2,500. We'll say that overcharges not refunded will come to $500 a year. These contributions to capital, which are credited to the members who made them, will be used to pay back the loan. At this rate the coöperative would be out of debt by the end of 1951.

Beginning in 1952, the association will start to pay back to its own members their first contributions—the original $2,500—at the same rate. Once that is done, the coöperative can proceed to pay back the money collected through overcharges each year, starting with the members' contributions in the first year, 1947, and working ahead chronologically.

The association's capital is then on a revolving fund basis. New capital is acquired by overcharges, and oldest capital subscriptions are paid back. This permits an equitable working arrangement between new members and retiring members, and between large operators and smaller operators within the group.

**Table 2**

| Year | Total membership investment at beginning of year | Mortgage debt at beginning of year | Capital added by ....c per unit overcharge | Capital revolved | Total membership investment at end of year |
|---|---|---|---|---|---|
| 1947 | $2,500 | $2,500 | $500 | ... | $3,000 |
| 1948 | 3,000 | 2,000 | 500 | ... | 3,500 |
| 1949 | 3,500 | 1,500 | 500 | ... | 4,000 |
| 1950 | 4,000 | 1,000 | 500 | ... | 4,500 |
| 1951 | 4,500 | 500 | 500 | ... | 5,000 |
| 1952 | 5,000 | ..... | 500 | $500 | 5,000 |
| 1953 | 5,000 | ..... | 500 | 500 | 5,000 |

According to the books of a coöperative, an individual member's account might look like this:

**Table 3**

| Year | Investment at beginning of year | Capital contributed on ....c overcharge | Capital revolved to member | Investment at end of year |
|---|---|---|---|---|
| 1947 | $300 | $40 | .. | $340 |
| 1948 | 340 | 40 | .. | 380 |
| 1949 | 380 | 40 | .. | 420 |
| 1950 | 420 | 40 | .. | 460 |
| 1951 | 460 | 40 | .. | 500 |
| 1952 | 500 | 40 | $40 | 500 |
| 1953 | 500 | 40 | 40 | 500 |

## OPERATING DETAILS ARE IMPORTANT

The Board of Directors of a coöperative may appoint an operations committee, unless the board itself takes on the duties of such a committee. Each producing district in the area should be represented on the committee, which will meet at the beginning of the season to:

1. **Hire operators**
2. **Determine route to be taken**
3. **Establish charges**
4. **Set rates of pay for operators**

Operations committee meets again at the end of the season to:

1. **Provide for care and improvement of machines**
2. **Arrange for collection of any charges not yet paid to the coöperative**
3. **Wind up season's activities**

Although all these duties are assigned to the operations committee, the actual day-to-day responsibilities usually fall to one person, who sees to it that the machines are kept in repair and moved from place to place on schedule.

OPERATORS are usually small farmer members who are able to be away from their own business. They must be interested in the association, and must know seed equipment and good seed. If he is hired on a per sack basis, an operator may be required to furnish his assistant or sack sewer, his own transportation (apart from the cleaner itself), and all gasoline and oil. If he is hired on an hourly basis, the operator may receive a 2 or 3 per cent bonus to keep him from wasting time.

Some associations ask their members to furnish any additional help needed when the portable cleaner comes to their farm; others ask the operator to provide the extra hands. In some coöperatives, operators obtain meals from the farmer on the job, while in others they furnish their own meals. In some cases trailers provide sleeping quarters.

ROUTES. Some associations send out return postcards to their members before the start of the season, and plan the route of the portable machines on the results of their questionnaire. In other coöperatives the operator is allowed to decide what route to follow.

CHARGES. Charges are all made on a per sack basis, regardless of weight. Wheat charges are usually the lowest, while sudan, oats, and vetch are highest. Charges are set each year by the operations committee or by the Board of Directors. A sliding scale based on the size of the job is the fairest way to determine charges. Some associations prefer to charge less if the number of sacks is above a certain limit, and more if the number is below a set minimum.

ACCOUNTS. Coöperatives should try to operate on a cash basis. Collection of charges by the operator on completion of a job keeps costs down. The secretary of the association and the operator keep in touch during the season, so that the association has at all times a summary of operations to date. When he makes this report, the operator turns over the money he has collected to that time, and is in turn paid for his services to that date. The secretary may be a Farm Bureau secretary, or he may be hired by the coöperative and paid on a percentage of gross receipts.

REFUNDS. In a coöperative, a refund is a repayment of an overcharge. Overcharges are necessary to provide a safe margin on which the coöperative can operate. Some associations try to set their charges so that there is little or no refund, and let what small overcharges there are accumulate as a reserve fund. This, of course, cannot be done when the coöperative is new and needs more funds than

could be provided in this way. Even a well-established coöperative may have trouble keeping the amount of overcharge small enough that members will not demand a refund. An association may also have difficulty with its tax status if this practice results in considerable funds on hand.

AUDITS. It is wise to audit books annually, and to provide members with a statement covering operations during the year and a balance sheet at the close of the year. State law requires a yearly audit unless it is expressly eliminated in the by-laws of the coöperative.

## VOLUMES AND COSTS

HOW LITTLE? Several grain-cleaning coöperatives report that in order to break even the machine must clean at least 10,000 sacks per season. When the volume was less than this, the coöperative went into the red.

HOW MUCH? How much business a coöperative can do in a year depends on:

**1. Length of season—the time between harvest and seeding**

**2. Size and efficiency of the equipment that can be mounted on a farm truck**

**3. Distances between jobs**

**4. Average number of sacks handled per setting (at each stop)**

**5. Amount of labor used**

Since operators are paid on a per sack or per hour basis, they can be counted on to work the maximum number of hours a day, and length of working day is therefore not a factor.

**Table 4**

**NUMBER OF SACKS OF GRAIN HANDLED (CLEANED AND TREATED) BY SAN LUIS OBISPO FARM BUREAU GRAIN IMPROVEMENT ASSOCIATION**

| Year | Number of machines | Wheat | Barley | Oats | Sudan | Rye | Vetch | Oats and vetch | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1926 | 1 | 2,250 | ..... | ..... | .. | .. | ..... | ..... | 2,250 |
| 1927 | 1 | 14,000 | ..... | ..... | .. | .. | ..... | ..... | 14,000 |
| 1928 | 1 | 21,165 | ..... | ..... | .. | .. | ..... | ..... | 21,165 |
| 1929 | 1 | 21,000 | ..... | ..... | .. | .. | ..... | ..... | 21,000 |
| 1930 | 2 | 20,460 | ..... | ..... | .. | .. | ..... | ..... | 20,460 |
| 1931 | 2 | 23,000 | ..... | ..... | .. | .. | ..... | ..... | 23,000 |
| 1932 | 2 | 23,100 | ..... | ..... | .. | .. | ..... | ..... | 23,100 |
| 1933 | 2 | 24,236 | ..... | ..... | .. | .. | ..... | ..... | 24,236 |
| 1934 | 3 | 23,509 | 2,719 | 1,358 | .. | .. | ..... | ..... | 27,586 |
| 1935 | 3 | 37,763 | 5,583 | 5,160 | 398 | .. | ..... | ..... | 48,904 |
| 1936 | 3 | 34,302 | 5,708 | 3,261 | 164 | .. | ..... | ..... | 43,435 |
| 1937 | 3 | 45,920 | 6,456 | 5,237 | 471 | .. | ..... | ..... | 58,084 |
| 1938 | 3 | 39,483 | 7,960 | 4,724 | 349 | .. | ..... | 410 | 52,926 |
| 1939 | 3 | 39,563 | 12,088 | 10,268 | .. | .. | ..... | ..... | 61,919 |
| 1940 | 3 | 46,398 | 7,585 | 9,397 | 392 | .. | ..... | 1,808 | 65,580 |
| 1941 | 3 | 33,017 | 11,160 | 1,886 | 47 | .. | ..... | 247 | 46,357 |
| 1942 | 3 | 25,133 | 18,837 | 5,751 | 25 | .. | ..... | 3,551 | 53,297 |
| 1943 | 3 | 31,003 | 10,575 | 8,501 | 54 | 26 | ..... | 4,670 | 54,829 |
| 1944 | 3 | 34,123 | 10,243 | 8,840 | 615 | .. | ..... | 8,517 | 62,338 |
| 1945 | 4 | 36,395 | 9,294 | 7,508 | .. | .. | 1,004 | 13,253 | 67,454 |
| 1946 | 4 | 41,946 | 14,682 | 4,159 | 147 | .. | ..... | 12,660 | 73,594 |

Table 4 shows the history of operations of coöperative seed-cleaning units in San Luis Obispo County. In that county 20,000 sacks per unit per season appears to be the greatest number that can be handled. In another area, where the average job is twice as large as that in San Luis Obispo County, and where about twice as much labor is used, one unit has handled as many as 38,000 sacks in a season.

SIZE OF EACH JOB. In San Luis Obispo County, the average size job is 150 sacks. A few run as high as 2,000 sacks. In some counties the average job is 300 sacks per setting—a term used to indicate each time a portable unit is set up for operation.

The operations committee in San Luis Obispo County sets a minimum of 50 sacks per setting. They found this necessary because of the cost of setting up equipment, adjusting screens and air blasts, and cleaning out the machines after each setting. For these reasons, costs per sack become less as the number of sacks per setting increases. A sliding scale of charges based on the size of the job makes it possible to lower the minimum number of sacks per setting by slightly increasing the charges for small jobs.

COSTS OF OPERATIONS. Table 5 shows the average cash costs of operations for a grain-cleaning coöperative from 1938 to 1946. Due to the rise in prices during that period, these averages are below what costs would be today.

Since the equipment will each year be older and more worn, actual charges must be greater than the cash costs shown here. To keep machines from becoming out of date or badly worn, most coöperatives repair and replace parts frequently, and make changes and improvements for better operation. Thus annual upkeep costs may be high, but depreciation will be greatly reduced.

**TABLE 5**

**AVERAGE CASH COSTS OF OPERATING A COÖPERATIVE GRAIN-CLEANING ASSOCIATION, 1938-1946**

| | Cents per sack* | Per cent of total |
|---|---|---|
| Labor | 10.12 | 63.1 |
| Repairs | 2.07 | 12.9 |
| Dust and twine | 1.54 | 9.6 |
| Insurance | .52 | 3.2 |
| Taxes and license | .11 | .7 |
| Supplies | .14 | .9 |
| Miscellaneous | 1.54 | 9.6 |
| Total | 16.04 | 100.0 |

* All charges are on a sack basis, regardless of weight.

In order that the information in our publications may be more intelligible it is sometimes necessary to use trade names of products or equipment rather than complicated descriptive or chemical identifications. In so doing it is unavoidable in some cases that similar products which are on the market under other trade names may not be cited. No endorsement of named products is intended nor is criticism implied of similar products which are not mentioned.

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